JITC/JTDB **26 January 1998**

WHITE PAPER
RETIREMENT OF RPF FORMAT
(DRAFT, Revision 3)

1 PURPOSE: The National Imagery and Mapping Agency has expressed the desire to establish a plan for retiring the Raster Product Format (RPF) as part of their 'Raster Product Convergence' effort. This desire is based upon the objective to increase commonality of format among geospatial products by reducing the number of variants of support data extensions. This white paper provides a starting point for summarizing the current state of affairs for RPF based products and their use in the field. It provides the beginnings of a technical analysis of what will need to happen to retire the RPF while limiting adverse impact on field use of the RPF based products.

2 REFERENCES:

2.1 MIL-STD-2411, Raster Product Format, 6 October 1994

2.2 NOTICE OF CHANGE Military Standard, Raster Product Format (RPF), 17 January 1995

2.3 MIL-STD-2411-1, Registered Data Values for Raster Product Format, 30 August 1994

2.4 MIL-STD-2411-2, Integration of Raster Product Format Files Into the National Imagery Transmission Format, 26 August 1994

2.5 Compressed ARC Digitized Raster Graphics (CADRG), 6 OCTOBER 1994

2.6 Controlled Image Base (CIB), 15 May 1995

2.7 MIL-PRF-89034, Digital Point Positioning Database (PPDB)

2.8 MIL-STD-188-199, Vector Quantization Decompression for the National Imagery Transmission Format Standard, 27 June 1994 (as updated by Notice 1, 27 June 1996)

2.9 Standard Geospatial Support Data Extensions, Draft, 25 February 1997

2.10 DIGEST Part 2, Edition 2.0, Draft 1, Annex D -

2.11 DIGEST Part 2, Edition 2.0, Draft 1, Annex E - Standard ASCII Table of Contents, December 1996.

3 BACKGROUND:

3.1 The Raster Product Format (RPF) is a standard data structure developed by DMA for geospatial databases composed of rectangular arrays of pixel values (e.g. in digitized maps or images) in compressed (VQ) or uncompressed form. RPF was intended to enable application software to use the data in RPF format on computer-readable interchange media directly without further manipulations or transformation, as defined in MIL-STD-2411.

3.2 The National Imagery Transmission Format Standard (NITFS) is a collection of related standards and specifications developed by the Central Imagery Office (CIO) to provide a

foundation for interoperability in the dissemination of imagery and imagery-related products among different computer systems, as defined in MIL-STD-2500 and MIL-HDBK-1300.

3.3 Because NITFS was the standard of choice by the imagery community for formatting raster imagery, a determination was made to integrate RPF file structures into NITFS. This was accomplished by a number of interrelated actions. The VQ compression algorithm developed for RPF was added to the set of supported decompressions used in NITFS. The structure and functionality of masking tables was added to NITF to support defining non-meaningful (pad) pixels within image blocks and to mark empty image blocks which are not included in the file data stream. A set of tagged record extensions were defined to hold the geospatial data associated with the RPF map or image. A tagged record extension was also established to provide RPF reader software with a byte off-set index into the NITF structured file. This allowed for minor changes to then existing RPF reader software to enable it to read the NITF structured files without the need to make the software fully NITF capable. Finally, a tagged record extension was created to allow RPF software to treat the set of NITF formatted files in a CADRG or CIB product as if they were a single file.

3.4 Consequently, the RPF software developed and distributed by DMA is hard-wired to only read CADRG and CIB products (a set of NITF formatted files) as produced by their respective production systems. If a NITF capable system modifies those files in any way (e.g. adding a graphical overlay such as a circle around an area of interest), the DMA RPF reader software will no longer be able to properly use the file. Although no comprehensive survey of user developed software capable of reading RPF products has been conducted, the same 'hard-wired' approach has been observed in several other RPF implementations.

3.5 Some NITF capable software systems have chosen to implement the optional Vector Quantization (VQ) decompression algorithm. These systems can decompress and view individual files included in the CADRG and CIB products. However, at this time, they are not capable of reading the RPF geospatial extension data. Neither can they treat the whole set of files on a CADRG or CIB product as a single raster map or image product.

3.6 As part of a cooperative international effort under the auspices of the DGIWG, a set of DIGEST based geospatial support data extensions (reference 2.9) have been developed looking forward to converging on the BIIF as a standard format for raster based imagery and mapping products. The BIIF has now been progressed as an ISO Draft International Standard (DIS). Only editorial and document formatting changes need to be done for BIIF to be published as an International Standard (IS).

4 ASSUMPTIONS:

4.1 Impacted Products. The only products being produced using the RPF format are:

- Compressed ARC Digitized Raster Graphics (CADRG)
- Controlled Image Base (CIB)
- Digital Point Positioning Database (DPPDB) (in that CADRG products are included as part of this product)
- SIM (system is still in prototype, product specification is only in draft)

4.2 Available Application Software. There may be a few commercial software applications (perhaps Vision International Softplotter and ESRI ArcInfo) currently available that read and

interpret RPF based products. However, since there are no established test criteria or controlled testing, the degree to which they fully read and properly interpret the products is uncertain. Some commercial NITF applications (e.g. ERDAS Imagine, Paragon ELT, Northrop VIEW, etc.) can decompress (VQ) individual RPF files, but do not read/interpret the RPF extensions. The Army's Topographic Engineering Center (TEC) has developed RPF reader software. A survey of user developed or acquired RPF reader software needs to be done to determine impact of change on the C/S/A's. Since all features of RPF are not present in CIB/CADRG products, it is uncertain how robust any of the RPF read-capable products are today. The only NIMA developed software applications that read RPF based products are:

- RPF Reader S/W on CADRG/CIB CDs
- DMA MUSE
- DEW_Drop (DPPDB sample s/w which read both the RPF extensions in CADRG and the DPPDB extensions in the stereo imagery files.)

4.3 GSDE. The objective to retire RPF essentially means to retire the RPF based tagged record extensions used in current CADRG and CIB products. The newer DIGEST based Geospatial Support Data Extensions (GSDE) are the preferred means to include geospatial data within NITF/BIIF formatted files. It is assumed that in developing the GSDE, all continuing requirements supported by the RPF extensions were fully incorporated in the GSDE specifications. This will need to be verified through technical analysis, but initial assessments indicate this to be the case with one functional exception. The RPF extensions not only carried geospatial data, but data describing the multi-file structure and interrelationships of the files contained on the product media. Recognizing this shortcoming, the DGIWG has developed a draft Annex E to the DIGEST to describe the 'Table of Contents' structure of multi-file products.

4.4 BIIF. It is NIMA's desire to eventually migrate the CADRG, CIB and SIM product production systems to use the NITF2.1/NSIF1.0 profile(s) of the Basic Image Interchange Format (BIIF). Application software which interprets and presents the contents of these products will need to support both NITF2.0 and NITF2.1/NSIF1.0 formats simultaneously for an indefinite period.

4.5 Legacy Products. NIMA needs to determine if they need to reproduce past RPF/NITF2.0 products using NITF2.1/NSIF1.0 with GSDE. This will have significant impact on the transition plan for migrating to the use of GSDE. Even if previously published products are regenerated in the new format, there will still be an abundance of old product on CDs out in the field.

4.6 Reader Alternatives. Among NIMA's alternative approaches for supporting applications that need to interpret these products are the following:

4.6.1 Product Viewer/Exploitation Software on Distribution Media. For this approach NIMA would either develop or acquire a fully capable NITF/BIIF viewer application which supports the needed support data extensions for these products. The viewer application would be distributed along with the product files and/or made available for central down loading. The application would need to be developed and supported such that it would run on a wide variety of hardware and operating system environments. NIMA would need to provide life cycle maintenance support for this application. This alternative includes the need to implement the following two alternatives.

4.6.2 Portable and Re-usable Software Modules for Integration Into Commercial Applications. NIMA would just develop software modules unique to the interpretation of the support data extensions of these products. The modules would be made available to commercial and government NITF/BIIF application developers for inclusion within their software applications. The modules would need to have life cycle maintenance and be supported across a wide variety of platform environments. This alternative includes the need to implement the following alternative.

4.6.3 Publish Specifications and Test Criteria for Interpret Applications. NIMA would just publish the specifications for compliant interpretation of the raster products along with their support data extensions. Along with the specifications, test criteria, test measures, and test procedures would be established to verify that applications properly interpret the data. If only this alternative is implemented, there may be a need to maintain a conformance test program available to all implementors, government and commercial.

4.6.4 Other?

4.7 Production Alternatives. The following are several production alternatives for consideration:

4.7.1 Scheduled Flash Cutover. Simply pick a date that production will shift from the legacy RPF/NITF to the new GSDE/NITF format. This alternative has the greatest impact on RPF product users. If users want access to the new data products, they will have to acquire the needed interpret software. The impact on customers would be reduced if NIMA were to provide the needed interpret software along with the products.

4.7.2 Overlapping Production Period. Produce both RPF/NITF and GSDE/NITF products in parallel during an extended transition period. This approach provides continued service to the users, but unless users are motivated to upgrade their interpret software, the dual production transition period may be excessive. A long duration of dual production may prove to be very costly.

4.7.3 Produce Combined RPF/GSDE Products. It is technically feasible to place both the RPF and GSDE data extension structures in the NITF files in a manner where legacy RPF readers can properly interpret the files and GSDE/NITF readers can do so as well. This approach may be lest costly than the dual production approach, but still provides little motivation for users to transition to the new GSDE structures. The impact of 'doubling' the geospatial data in the NITF files on the feasibility to produce and distribute products would need to be investigated if this approach is to be pursued.

5 DISCUSSION:

5.1 Scope of RPF Retirement. NIMA needs to determine how far they want to go in retiring RPF. Is the objective to just change the vocabulary from 'RPF' to 'NITF/SDTS/BIIF using RPF tags'? Is it to just reduce the amount of standardization documentation? Is it just to do away with hard-wired RPF viewer applications? Or is the objective a complete transition from RPF? The issue essentially boils down to determining how far the RPF tagged record extensions should be preserved into the future, and when the products should be transitioned to use the new GSDE. The ultimate objective should be to minimize the number of variants (alternate type of tagged extensions) that interpret applications need to support in the field to properly read/interpret image/geospatial products.

5.1.1 As far as the product format goes, there is no technical reason preventing the creation of these products in NITF2.1/NSIF1.0 or BIIF using the existing RPF extensions. However, continuing to use the RPF extensions when the goal is to use the DIGEST based GSDEs

will just prolong the need and cost of supporting two data structures and all the associated support documentation. Likewise, there is nothing preventing the use of the GSDEs in lieu if RPF extensions within NITF2.0 if the opportunity to transition to GSDEs precedes the transition to BIIF/NITF2.1.

5.1.2 Since there is little or no current documentation describing the proper use and interpretation (much less test criteria and measures) of either the RPF extensions or the GSDE extensions, it would seem beneficial to develop only one set of documentation for the use and application of GSDE by transitioning the product line away from RPF extensions. Existing RPF reader software could just be put in a maintenance state and used to read legacy products. (Note: The product specifications for CADRG and CIB do contain guidelines for interpretation of the product data.)

5.2 Plan of Action.

5.2.1 Technical Assessment. Conduct a requirements and technical format consistency comparison between MIL-STD-2411/2411-1/2411-2, the RPF Product Specifications, and the Geospatial Support Data Extension package (STANAG 4545 Annex D). The crosswalk should include:

- Comparison of capabilities and fundamental functions
- Comparison of support data elements for
  - element range and value sets
  - derivations- where data is taken from and consequence of using different sources, if any
  - content equivalency, existence, and/or absence
- Specify and define separations and compatibilities and suggested resolutions

5.2.2 Capital Investment Impact Assessment. Identify the technical and associated cost impact of modifying existing production systems and interpretation software to transition from RPF extension tags to GSDE tags. This step presumes the result of the technical assessment shows it to be feasible to produce technically equivalent products using GSDE vice RPF tags.

5.2.3 Nominate Documentation Structure. Identify the candidate documentation structure and cost estimates to develop and maintain the required documentation.

5.2.4 Implementation Requirements. Nominate the GSDE read, interpret, exploitation requirements and compliance criteria.

5.2.5 Business Plan. Prepare a migration plan and associated business case with projected cost impacts. This plan should show the need and cost benefit of the proposed change, candidate milestones, and estimated costs. It should highlight the expected benefits to the user community of these products. It should also identify the business strategy for how product interpretation software will be made available to the end users. See the suggested alternatives in paragraph 4.6 and 4.7 above.

5.2.6 C/S/A Coordination. Present the business plan to the CINCs, Services and Agencies and solicit their inputs. May want to involve the C/S/As in the preparation of the Business Plan from the start.

5.2.7 Execution Plan. Take needed budgetary actions to put the plan into place. Prepare Requests for Change (RFCs), Engineering Change Proposals (ECPs), and other acquisition documents needed to cause execution of the plan.

6 SUMMARY: This white paper outlines the major technical issues that need to be addressed to assess the impacts of adopting the DIGEST based GSDE in addition to, or in lieu of, the current use of RPF based extensions. Several technical alternatives for coping with changes to reader software and production systems have been introduced. If the desire is to continue with the investigation of what it would take to accomplish the transition, several suggested ‘next steps’ have been offered.